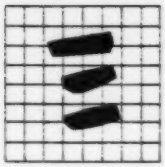
CANADA/NEW BRUNSWICK
CONSERVATION AND
ALTERNATIVE ENERGY AGREEMENT



L'ENTENTE CANADA/NOUVEAU-BRUNSWICK
SUR LES ÉCONOMIES D'ÉNERGIE
ET LES ÉNERGIES DE REMPLACEMENT

FINAL REPORT

HARVESTING NON-MERCHANTABLE STANDS FOR ENERGY CONVERSION

SHANNON, N.B.

1987

New Brunswick
Nouveau-Brunswick

Canada

D I S C L A I M E R

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FOREWORD

This report describes the Harvesting of Non-Merchantable Stands for Energy Conversion which was a project under the aegis of the Canada-New Brunswick Energy Conservation and Alternate Energy Agreement. The project was carried out in the period May-October, 1987.

The details of the harvesting are contained in Appendix 1.

1. EXECUTIVE SUMMARY

From May to October, 1987, a non-merchantable stand harvesting project was carried out on private land in the Shannon area of Southern New Brunswick.

The objectives of the project were:

- to determine the costs of harvesting, processing and delivering chipped non-merchantable wood for conversion into energy;

- to establish the efficient combination of manual and mechanical forces for economic production;

- and to determine the resultant economic benefits respecting reforestation of the harvested area.

It was determined that wood from non-merchantable stands on private woodlots can be harvested, chipped and hauled 90 Km. for $25 to $30 per Green Tonne ($38 - $46 per Bone Dry tonne).

To achieve these costs an industrial-sized chipping and delivery system must be used. Also roads on woodlots must be such that they can accommodate a large chipper and 40' - 45' chip vans.

Wood was felled with chain saws and brought full-tree to a well-built road with a cable skidder for this project. Costs were $7.70/Green Tonne ($11.80/B.D. tonne).

If there is no existing regenerating to be saved, and the organic layer on top of the soil is not too deep, then full tree logging with a cable skidder will prepare the harvested site for planting, thereby avoiding the need for a separate site preparation operation.

Potentially productive sites, presently occupied by non-merchantable trees, can be put into the growing of high quality softwoods through harvesting for wood energy.

A total of approximately 1500 Green Tonnes was chipped for this project.

1. SOMMAIRE À L'INTENTION DE LA DIRECTION

De mai à octobre 1987, un projet d'abattage des arbres d'un peuplement d'essences non commercialisables a eu lieu sur un terrain boisé privé de Shannon, dans le sud du Nouveau-Brunswick.

Voici quels étaient les objectifs de ce projet :

- établir le coût d'abattage des arbres non commercialisables, de leur transformation en copeaux et de la livraison des copeaux à une centrale électrique comme source d'énergie;

- trouver le dosage approprié de travail manuel et mécanisé afin d'obtenir une production économique; et

- établir quels seraient les avantages économiques qui résulteraient du reboisement des zones de coupe ainsi libérées.

Il a été établi que le bois issu des peuplements d'essences non commercialisables situés sur des lots boisés privés pourrait être récolté, réduit en copeaux et transporté sur une distance de 90 km pour 25 $ à 30 $ la tonne de bois vert (38 $ à 46 $ la tonne de bois sec).

Afin d'arriver à ces coûts, un système industriel de déchiquetage et de transport doit être utilisé. En outre, les routes des lots boisés privés doivent être en mesure de permettre la circulation d'une coupeuse-déchiqueteuse de format industriel et de camions de transport de copeaux de 40 à 45 pi.

Dans le cadre du projet, les arbres ont été abattus au moyen de tronçonneuses et transportés en troncs entiers à proximité d'une route carossable à l'aide d'une débusqueuse à câbles. Le coût de ces opérations a été de 7,70 $ la tonne de bois vert (11,80 $ la tonne de bois sec).

S'il ne se trouve aucun régénération préexistante à conserver sur le lot visé et si la couche de matières organiques en surface n'est pas trop profonde, une coupe à blanc au moyen d'une débusqueuse à câbles constitue une préparation suffisante du site aux fins du reboisement, ce qui évite ainsi d'avoir à effectuer une opération distincte de préparation du terrain.

Des emplacements ayant un potentiel de productivité intéressant et qui sont actuellement occupés par des arbres d'essences non commercialisables pourraient être libérés et servir à la production de bois de résineux de grande qualité grâce à l'abattage des arbres pour produire de l'énergie.

Au total, environ 1 500 tonnes de bois vert ont été déchiquetées dans le cadre de ce projet.

PROJECT: **HARVESTING NON-MERCHANTABLE STANDS FOR ENERGY CONVERSION**

DESCRIPTION:

The project was designed to identify the costs of production and the methodology for harvesting non-merchantable stands on small freehold forests. The area chosen is representative of hundreds of hectares of budworm-damaged forest particularly in southern New Brunswick. The project site is part of the land owned by McCrea Farms Ltd. at Shannon, Queens County and has a well-developed road system as an essential of a resource management plan.

OBJECTIVES:

To determine the costs of harvesting, processing and delivering chipped non-merchantable wood for conversion into energy;

To establish the efficient combination of manual and mechanical elements for economic production; and to determine the resultant economic benefits respecting reforestation of the harvest area.

OPERATION

The report on the harvesting and processing of the raw material was prepared by the consultant, David Baird of Baird, Lenihan & Associates Ltd. The following comments and observations supplement that report.

Weather conditions coupled with other commitments of the chipping contractor resulted in an estimated 100 tons of full trees being left at roadside. This mass is judged to be uneconomic for chipping per se, but could be processed in the spring of 1988 if adjacent areas are to be harvested and the non-merchantable material is processed..

The final activity in the project is the provision for the next crop and planting as required will be a function of the availability of seedlings and their allocation by the Southern N.B. Wood Cooperative.

BUDGET

Total Gross Production Cost 1650 gr. tons X $23.61	$38,956.00
Consultant	$10,000.00
Information Transfer (report, video, site tours, etc.)	$ 3,000.00
Miscellaneous	$ 1,000.00
Total Project Costs	$53,000.00
Sale Revenues	
Chips	$21,000.00
Other Products	$ 8,000.00
	$29,000.00

Net Cost: Harvesting cost less sales = 39,000 - 29,000 = $10,000

Net Cost per gr. ton = $\frac{\$10,000}{1650 \text{ gr. tons}}$ = $6.06/green ton.

INFORMATION TRANSFER

A field demonstration was held June 13, 1987 and 125 participated. The majority of the participants were woodlot owners and small harvesting contractors but consultants, industrial and governmental foresters and the media were represented as well.

The participants were transported by bus from a parking site on a public road to the demonstration site, five kilometres distant. In groups of 20 they moved in sequence to the felling and forwarding; the chipping and transportation; and the planting.

A boxed lunch and beverage were served on site, followed by remarks by Lawrence McCrea, owner of the project site, and forestry consultant David Baird.

In addition to newspaper articles on the demonstration interviews on radio were aired.

A video of the project was made by the Communications Branch, DNRE under the direction of L. Sleep. A copy will be available on loan for interested groups, particularly for woodlot owners planning to replicate the project.

DISCUSSION

The project was initiated on the basis of correlating standard harvesting procedures of woodlot owners with the economy of scale of industrial operations. The details of the actual harvesting and processing are set forth in the report of the consultant.

However, the total effects of the project should be considered and the results rationalized.

Harvesting

Productivity in harvesting was low because the felling and skidding were not coordinated on a sustained schedule. Perhaps the greatest improvement will be directional felling and pre-choking. The latter is more significant for 400-metre skidding distance. Tree sectioning and forwarding by porter are procedures which will increase productivity as well. The point is that as a percentage of the operation can, or will, be carried out by the owner, efficiency will be enhanced by modifying some methods.

Silviculture

The overall profitability of the project is illustrated by the elimination of site preparation and the accelerated reforestation. The standard allowance under governmental programs for site preparation is an equivalent of $1.25/ton (green). Planting the harvested site within the year of harvest may reduce the need to apply a herbicide for low value, competing vegetation.

In this instance one block of the harvested area was planted in July and the plantation will be monitored for survival, growth and herbicide treatment. It is this potential research follow-up which will provide valuable information for other woodlot owners.

The other blocks will be studied in the spring of 1988 to determine the degree of natural stocking and the need for artificial regeneration.

As well the areas of reproduction which were by-passed in the harvesting will be monitored in the coming years and treated as appropriate. The owner believes that a noncommercial thinning may be the initial treatment but he is prepared to undertake other options as conditions indicate.

Since there are options for securing the new crop a definitive value cannot be ascribed to the by-passed reproduction. However, the plan to plant immediately in one block and retain the reproduction in another provides better opportunities to determine specific resource management procedures and apply the results to other operations.

Combining the foregoing with Mr. Baird's report (Appendix A) it is believed that a nominal stumpage value of $1.00/ton should be included in the total cost of production and re-establishment of the forest. Incidentally, this amount is used in Maine and has been accepted by both producer and consumer as the best approximation of a value. Producers in Prince Edward Island have suggested $2.00/ton but admit it is an arbitrary figure and worthy of consideration.

Conclusion

On balance it would appear that improvements can be made in the harvesting and chipping which will result in lower costs. These will be offset to some degree by stumpage and supervision expenditures. The forest management benefits will be both immediate and long-term and will provide financial returns in like fashion.

The project results are a basis for a viable, economic enterprise to be undertaken by woodlot owners who can meet the criteria described in Appendix A and improve suggested alternative actions.

E.T. Owens, RPF.

Manager, Wood Energy Program

APPENDIX 1

HARVESTING NON MERCHANTABLE STANDS FOR ENERGY CONVERSION SHANNON, NEW BRUNSWICK 1987

BAIRD, LENIHAN & ASSOCIATES LTD.
FREDERICTON, NEW BRUNSWICK

Prepared by:

David R. Baird, P. Eng., R.P.F.

BACKGROUND

In the province of New Brunswick at present there are large areas of privately-owned land which at one time were forested in mixed-wood stands. Because of Spruce budworm attack on the softwood, these stands have become predominantly hardwood. In some cases as much as 25 percent of the wood volume in these stands is of sufficient quality and within economical distance of markets, as to be considered merchantable. the remainder of the wood volume in these stands is of sufficient quality and within economical distance of markets, as to be considered merchantable. The remainder of the wood volume in these stands, in many areas of the Province, however, has no market. The developing wood energy industry is considered to be a viable alternative, if an efficient system can be put in place to harvest and deliver wood particulates.

Many woodlot owners are concerned with long-term management of their land. They must consider reforesting cut-over land in a desirable species and in an economical manner. In most cases market demand dictates that softwoods be the choice for reforestation. There are federal and provincial government programs available which assist land-owners in reforestation.

It was proposed, as a result of the foregoing considerations, that a non-merchantable stand harvesting project be carried out in the southern area of N.B. The objectives would be:

- to determine the costs of harvesting, chipping and delivering non-merchantable wood for conversion into energy;

- to establish the efficient combination of manual and mechanical forces for economic production;

- and to determine the resultant economic benefits respecting reforestation of the harvested area

An agreement was entered into with a landowner in the Shannon area of southern N.B. to conduct such a project. The landowner, Mr. Lawrence McCrea, and his family, manage approximately 1500 hectares of farmland and woodland. These lands are managed for total resource appreciation. A forest inventory is maintained and an annual allowable cut is followed by adhering to an operational plan for the forest.

Essential to the management plans for the McCrea woodlots is a well-built and well-maintained road system. This road system enables the McCrea's to harvest or conduct silviculture operations on almost any corner of their land as market opportunities or stand conditions dictate. The implementation of this wood energy project was a good example of how an existing road system enabled the McCrea's to provide a readily available supply of wood for a new market.

An area on the McCrea woodlot adjacent to an existing haul road was chosen for the site of the project. The soil on the site was shallow clay-loam type covered by a light layer of duff. The site was generally well-drained due to the rolling type of terrain. Softwoods (i.e. balsam fir and white spruce) had been ravaged by spruce budworm infestations over the past fifteen (15) years. As a result, stands which were once mixtures of hard and softwoods had now become composed mostly of maples, birch, and a few poplar. Pockets of cedar remained as did scattered spruce trees. The quality of the hardwoods was poor. Small portions had potential for veneer and spoolwood,but most were too crooked, too limby, or too small for any available markets. No hardwood pulp and paper mill is situated in close enough proximity to warrant full-tree chipping for fibre production.

The owner's goals in choosing the sites for this wood energy project were:

- to realize the full economical potential of each tree on the site by directing portions of it to available markets

- to clear the site of all hardwood, including tops so as to facilitate follow-up treatments

- to as economically as possible chip and deliver all unmarketable hardwoods to a wood-burning plant

- to put the site into the production of softwoods, with the least possible cost

The owner's goals coincided with the long-term goals of wood energy and forest management proponents of the project (i.e. to use a wood energy harvesting program as a means of managing forest lands for softwood production and as a means of generating money for hitherto unmarketable wood).

The project site was divided into 3 blocks - A, B and C (See Map of Area, Figure I).

Block A (8.5 hectares) was harvested from May 4th to June 3rd, and was cut with the intention of preparing the site during the harvesting operation. Very little softwood seed source or advance regeneration was evident prior to logging.

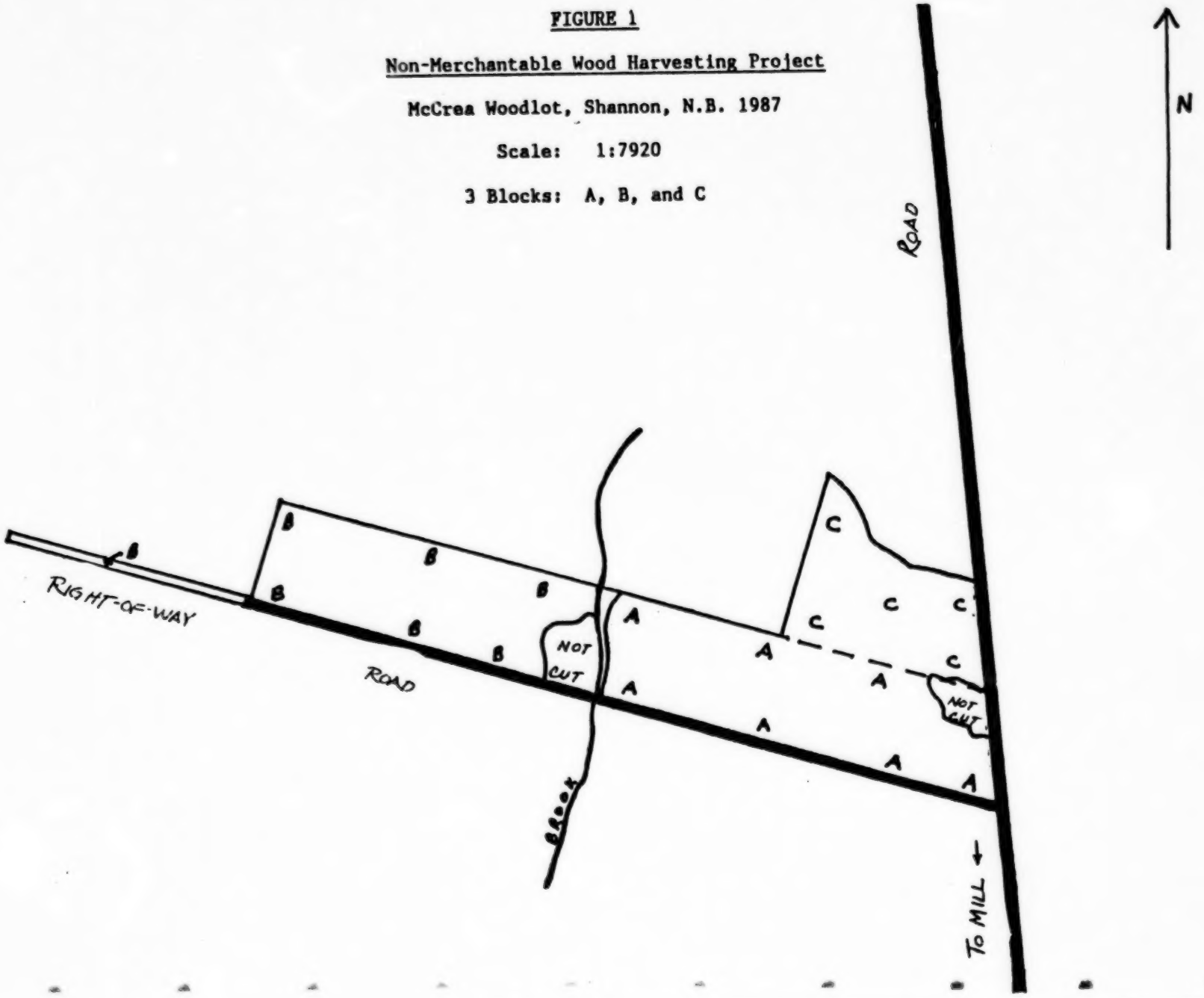
FIGURE 1

Non-Merchantable Wood Harvesting Project

McCrea Woodlot, Shannon, N.B. 1987

Scale: 1:7920

3 Blocks: A, B, and C



Block B (7.8 hectares) was harvested from June 4th to July 23rd, with the intention of relying as much as possible on existing natural regeneration to stock the site after logging. Many patches of softwood (in the 0.5 to 3 meter height range) existed prior to logging and it was decided to log Block B in a different manner than Block A., so as to preserve these young softwoods.

Block C (5.0 hectares) was harvested from July 24th to Sept. 1st. It was similar to Block A and was logged in the same manner.

Maximum skidding distance for blocks A and B was 200 meters, and for block C was 400 meters.

DESCRIPTION OF OPERATION

The operation was broken down into five phases for purposes of the study:

A) Felling

B) Skidding

C) Chipping

D) Delivery

E) Reforestation

A brief description of the methods and equipment used in each phase follows:

A. & B. Felling and Skidding: These two operations were contracted out on a piecewood basis. The contractor operated a 1968 Timberjack 230D cable skidder, and for a good portion of the project hired a feller on a daily rate to perform the felling. Softwoods were limbed and topped at the stump and brought to roadside with full-tree hardwoods. The skidder operator separated softwoods from hardwoods at roadside. Quality hardwood logs were also separated by the skidder operator at roadside during the piling process.

Attempts were made to skid over almost all the ground in Blocks A and C in order to prepare the entire Blocks for planting. To preserve the large amount of advance regeneration in Block B, skid trails were carefully established, and the same trails were used as often as possible.

C. & D. Chipping and Delivery: These two operations were also contracted out on a piecework basis. The contractor used an older model 22" Morbark chipper (complete with 3-knife disc chipping wheel) mounted in conjunction with a Barko 160 Loader, and brought this equipment to the site three (3) times to chip whatever wood was available each time. Two men were present on the chipping operation at all times. The contractor was responsible for delivery of the chips and therefore made arrangements to use either his own or other trucks. For the most part 45 foot tri-axle, air-lift chip trailers were used, and all but three (3) loads were delivered to the Irving Pulp and Paper Mill in Saint John, 94 Km away.

E. Reforestation: Reforestation to date has consisted of planting Block A with Black Spruce container stock. This was done with the S.N.B. Marketing Board acting as the planting contractor.

Costs of planting were subsidized under the Canada/New Brunswick Forest Development Agreement. Purchase of the trees for Block A was completely subsidized as compared to normal 50 percent subsidization. Non post-cut treatments in Block B and C have taken place at the time of the writing of this report.

Plans are for Block C to be reforested in the same manner as Block A as it was logged in the same manner. It is unlikely, however, that there will be a subsidy of more than fifty percent for the further purchase of planting stock.

Plans for Block B are as yet uncertain. A delay of at least a year will be required to assess the success of the logging method used with respect to saving existing regeneration. It is possible that portions of the block will be released using herbicides. Other portions may be planted.

MONITORING METHODS

Volume tables were formulated from length samples taken on site, and from Canadian Forestry Service bio-mass tables. All trees piled in the hardwood full-tree pile were counted. Twenty percent of the pile faces were butt-scaled, and estimates of production were made by multiplying the average volume and weight of the pieces scaled, by the number of pieces in the piles.

Random time studies on felling, skidding, chipping and trucking were done to determine productivity and reasons for variations in productivity.

Moisture content was determined on samples of freshly cut wood and on freshly chipped wood. The process was fairly simple and involved taking weights of small samples in the green and in the oven-dry conditions. Moisture contents of the chips averaged 34.6 percent.

No consistent rates of moisture loss over time could be determined from the data. Moisture content loss appeared to be insignificant in this project.

PRODUCTIVITY

A. & B. Felling and Skidding:

The man-day production in each block did not reflect the average tree size found in the piles (Table 5.1).

TABLE 5.1

	Block A	Block B	Block C
Tress/B.D.t.	14.3	11.7	21.4
B.D.t./man-day	8.95	6.1	7.7*
B.D.t./machine-day	17.9	11.1	7.7*
Other Products (m^3/hectare)	13.6	22.2	4.8

*A one-man crew was used in Block C.

Block B had the largest trees and yet man-day production was lowest in this block. Two reasons can be found to account for at least part of this seeming contradiction:

1) An attempt was made in Block B to save as much of the coniferous advance growth as possible, mainly because there was an abundance of it. This is more time-consuming with a cable skidder than is the method of skidding used in Blocks A and C, where total site preparation was one of the objectives of the skidding phase.

2) Block B contained more salvageable softwoods than did Blocks A and C (see "Other Products" in Table 5.1). Because these were harvested and processed in conjunction with the harvesting of non-merchantable material, the daily production rate of the latter declined.

Machine-day production was 71 percent higher in the two-man crew situation versus the one-man crew, (Appendix 2) but the one-man crew had much smaller trees to deal with.

Twenty-five (25) random samples were taken of felling times over the course of the project. Average trip time was 31 minutes and average trees/trip was 14.2. The 31 minute total trip time was broken down into 19 minutes productive time and 1 minute of non-productive time. Essentially the non-productive time was sitting time - i.e. the feller performed non useful work. Productive time (19 minutes/trip) included 3 minutes of assisting the skidder operator in choking and one-minute of working on the saw. Very close to one minute per tree was averaged when felling of non-merchantable trees was being carried out.

Thirty-one (31) random samples were taken of skidding times over the course of the project. Average trip time was 27 minutes (vs 31 minute average found on the felling samples). Table 5.2 shows how this 27 minutes was broken down.

TABLE 5.2 - AVERAGES OF SKIDDER'S TRIP TIMES

	Total Trip Time	Travel to Stump	Collecting Load	Travel to Road	Road Side	Repair
Mins.	26.6	3.8	11.4	3.6	6.7	1.1
%	100%	14%	43%	14%	25%	4%

Only 28 percent of the average total trip time was spent travelling - work for which a skidder is required.

C. Chipping:

Twenty (20) random samples were taken of chipping times out of a total of 57 loads. Load sizes averaged 26.27 Green Tonnes (17.2 Bone Dry tonnes). The average total loading time was 65.3 minutes. Table 5.3 shows a breakdown of this time.

TABLE 5.3 - LOADING TIME

	Total Loading Time	Actual Chipping Time	Moving	Repair and Fueling	Positioning of Truck
Mins.	65.3	49.7	1.3	4.85	9.45
%	100%	76%	2%	7%	15%

Loading time was defined as commencing with the positioning of the chipper and truck for loading, and finishing when the chipping of a load is completed. Average time for the positioning of a truck and chipper was 9.45 minutes or 15 percent of loading time as indicated in Table 5.3. However, this average was 6.8 minutes (10.8%) for trucks backing in versus 15.6 minutes (21.8%) for trucks driving past the chipper, and then turning around.

Non-loading time was also sampled. For two of the twenty samples, the time spent waiting for trucks to return averaged 4 hours and 38 minutes. Disregarding these two samples, non-loading time was broken down as shown in Table 5.4.

TABLE 5.4 - NON-LOADING TIME

	Total N-L Time	Repair	Fuelling	Changing Knives	Other*
Mins.	17.45	3.85	0.8	5.1	7.7
%	100%	22%	5%	29%	44%

*Other = meals, cleaning road, etc.

By adding the figures in Tables 5.3 and 5.4 the total time for a load is 65.3 + 17.45 = 82.75 minutes. This breaks down as:

	Minutes	%
Chipping	49.7	61%
Moving and Positioning	10.75	13%
Repair and Fueling	9.5	11%
Changing Knives	5.1	6%
Other	7.7	9%
Total	82.75	99%

Production rates for chipping can therefore be calculated as follows:

Average Load: 26.7 Green Tonnes or

17.2 Bone Dry tonnes

Average Total Loading Time: 82.75 minutes = 1.38 hours

Production Rates: 19.34 Green Tonnes/hour or 12.46 B.D.t./hour

Man-hours and machine-hours per day varied so much (both Actual and Scheduled) that a typical 8 hour day does not seem realistic. However, assuming an 8 hour day for reporting purposes, then chipping production averaged:

- 77.4 Green Tonnes/man-day
- 49.8 B.D.t./man-day
- 154.7 Green Tonnes/machine-day
- 99.7 B.D.t./machine-day

D. Delivery:

The haul distance to the Irving Pulp & Paper Mill in Saint John was 94 Km. of which 5 Km. were low-speed gravel road. Averages obtained from samples on truck times are broken down for an average trip as follows:

Positioning for chipper	-	9.45	mins.
Loading	-	55.85	
Close up Load	-	3.8	
To Mill and Return	-	231.0	(1 sample only)
Total Time	=	300	minutes = 5.0 hours

Production figures on this haul were:

Green Tonnes/man-hour	=	5.25
B.D.t./man-hour	=	3.44
Green Tonnes/machine-hour	=	5.25
B.D.t./machine hour	=	3.44

E. Reforestation

Block A (8.5 hectares) was planted with 20,480 Black Spruce containers immediately after harvesting (last week of June, 1987). The skidding operation served as the only site preparation required. Planting production for the six person crew (including foreman) was 20 man-days. Ground in the area is generally difficult to plant because of shallow rocky sites. The crew had expected even tougher planting because of extra skidder compaction on Block A, but found that this was not the case.

COSTS

Total costs to produce and deliver the 1497.5 Tones (979.4 B.D.t.'s) were kept by the landowner and were broken down on a unit basis as follows:

		Unit Costs* Per		
		Green Ton	Green Tonne	Bone Dry tonne
1.	Cut and Skid	$ 7.00	$ 7.72	$11.80
2.	Fringes	$ 0.70	$ 0.77	$ 1.18
3.	Chipping	$ 7.00	$ 7.72	$11.80
4.	Trucking (94 Km haul)	$ 8.00	$ 8.82	$13.49
5.	Clean-up (estimated by owner to be $1500.00)	$ 0.91	$ 1.00	$ 1.53
	TOTAL	$23.61	$26.03	$39.80
Unit selling price to Irving Pulp & Paper		$12.00	$13.23	$20.23

*Above unit costs, do not include any allowance for road construction, stumpage, supervision or reforestation.

Site preparation for any follow-up forest renewal work, in any of the three blocks, will not be required due to the effects of full-tree logging on the sites. Costs for planting of Block A (8.5 hectares) were:

Tree Purchase = $0.13 / tree

Tree Planting = $0.14 / tree

Federal/Provincial forestry assistance programs in 1987 enabled N.B. landowners to purchase trees at $0.065. These costs were absorbed by the Southern New Brunswick Wood Co-op for trees planted on Block A.

The planting cost of $2,867.20 (0.14/tree X 20,480 trees) on Block A was subsidized by $1651.18 under the Federal/Provincial forestry program. Therefore, the landowner was actually able to buy trees and have them planted on the 8.5 hectares of Block A for $1216.02 or $143.06/hectare. Should 50 percent of the tree purchase cost have been paid by the landowner, as is normally the case, then his planting costs would have totaled $350.87/hectare.

A savings in site preparation dollars in the vicinity of $75 - $150 per hectare was made in Block A through use of the harvesting system.

Plans are for a portion of the 7.8 hectares of Block B and the 5.0 hectares of Block C to be planted. Planting costs, (in 1987 dollars) when taking full advantage of subsidies, would be $350.87/hectare. Maintenace programs will, in all likelihood, be required on each of the Blocks A, B and C in the next 10 years. Herbicide and spacing programs are at present heavily subsidized by Federal/Provincial forestry agreements.

CONCLUSIONS

Wood from non-merchantable stands on private woodlots can be harvested full-tree, chipped, and delivered to a market in a 90 - 100 Km haul radius, for $25-$30/Green

Tonne ($38-$46/B.D. tonnes). To achieve these costs an industrial-sized chipping and delivery operation must be in place, with equipment being moved from woodlot to woodlot, when sufficient volumes (200 Tonnes plus) are available at roadside.

The portion of a woodlot's road system, which will be required to accommodate a chipping operation, should be built to industrial standards. Barring this, a bulldozer should be available at all times.

Should a pre-cut inspection indicate stand renewal will involve planting, then full-tree logging can be conducted using a cable skidder. The site can be adequately prepared for planting during the harvesting operation - provided duff layers are not unreasonably deep.

RECOMMENDATIONS

(a) A major problem with this particular project was the dependability and availability of industrial chippers and trucks. Should a 20,000 Tonnes + operation on small woodlots be organized, priority to the operation must be guaranteed by the chipping and hauling contractors.

(b) Woodlot owners participating in a wood energy program would almost certainly have to commit themselves to a production schedule (i.e. guarantees that X tonnes would be available at certain dates would

have to be made). A contractor chipping 150-200 Tonnes daily would always need to know the location of the next 15-20 days inventory in order to organize the various aspects of his operation.

(c) Roads suitable to load and haul with long chip vans must be in place or bulldozers must be available to push/pull trucks, if needed.

(d) Avoid putting Cedar in piles to be chipped. Cedar decreases productivity by dulling knives rapidly.

(e) Piles should be perpendicular to the road (not at angles) in order to maintain optimum chipping production. Also piles should be built so that trees can be fed into the chipper in reverse order to piling (i.e. last trees on pile are first ones into chipper).

(f) Piles should contain minimum amount of rotten softwood, and large limbs and tops should be partially cut so as to facilitate feeding the chipper.

(g) Piles should be at least 30 Tonnes in size to minimize moves during chipping.

(h) Productive chipping can occur only if trucks are continuously available for loading. On this project low truck availability and long truck turn-around times were the major contributors to chipper idle time.

(i) If possible each site should be laid out such that trucks can turn around before they reach the chipper and then back up to the chipper.

(j) Moisture content loss from time of cutting to time of chipping appears to be minimum. However, pile age should be kept to 2-months if possible, to avoid excessive moisture loss.

(k) If a cable skidder is being used, the feller must assist in the choking process. In this project the feller had excessive idle time, provided little assistance in choking, and did not directionally fell. Consequently, production was such that for only 28 percent of the time was the skidder actually travelling.

(l) If softwood and unmerchantable hardwoods are to be part of the same harvesting operations, they should be skidded to roadside separately (i.e. each twitch should be either softwood or hardwood so as to lessen unloading time at the pile).

(m) Head logs along the road edge, on which the butts of the bottoms logs in a twitch can be rested, would lessen unchoking time considerably.

(n) If advance softwood regeneration is to be saved, then a cable skidder is not a good choice of forwarding equipment.

(o) coversely, if no existing regeneration is to be saved, a cable skidder pulling full trees to roadside will align brush, and will prepare sites for planting in many cases.

(p) Consideration might be given to using site preparation savings (dollars) to further assist woodlot owners in the purchase of seedlings.

APPENDIX 2

PRODUCTION - ONE-MAN CREW vs. TWO-MAN CREW - CUT AND SKID

	Two-Man Crew	One-Man Crew	Total
Tree	9077.0	5526.0	14,603.0
Man-Days	99.0	33.5	132.5
Machine-Days	49.5	33.5	83.0
Green Tonnes	1073.0	424.5	1497.5
B.D. Tonnes	701.7	277.6	979.4
Tress/B.D. t.	12.9	19.9	14.9
B.D.t./man-day	7.1	8.3	7.4
B.D.t./machine-day	14.2	8.3	11.8

APPENDIX 3

CUT AND SKID PRODUCTION DATA BY BLOCK

	BLOCK A	BLOCK B	BLOCK C	TOTAL
Hectares	8.5	7.8	5.0	21.3
Trees	5743.0	4228.0	4632.0	14,603.0
Green Tonnes	615.9	550.4	331.2	1497.5
B.D. Tonnes	402.8	360.0	216.6	979.4
Man-Days	45.0	59.5	28.0	132.5
Machine-Days	22.5	32.5	28.0	83.0*
Other Products(m)	115.9	173.5	24.1	313.5
Trees/m	16.0	13.8	21.6	16.6
Trees/Green Tonne	9.3	7.7	14.0	9.75
Trees/B.D. Tonne	14.3	11.7	21.4	14.9
Green Tonnes Chips per Hectare	72.5	70.6	66.2	70.3
Other Products per Hectare	13.6	22.2	4.8	14.7
B.D.t./Man-day	8.95	6.1	7.7	7.4
B.D.t./Machine-day	17.9	11.1	7.7	11.8

*Note - Scheduled Machine-days = 87

APPENDIX 4

Conversion Factors:

1 cunit	=	2.83 cubic meters (m^3)
1 hectare	=	2.47 acres
1 tonne	=	1.1025 tons
1 B.D.t.	=	1 Bone Dry tonne = 1.1025 B.D. tons

$$\% \text{ Moisture Content} = \frac{\text{Weight of water in Green Wood}}{\text{Total weight of Green Wood}}$$

Example:

34.6% Moisture Content means that in 100 tonnes of green wood there is 34.6 tonnes of water and 65.4 Bone Dry Tonnes of wood